

Table 3



Sample	Material composition (mass %)										Sintering condition temperature × time × pressure (°C) × (hr) × (MPa)	HIP condition temperature × time × pressure (°C) × (hr) × (MPa)	Porosity (%)	Electric resistance (Ω · cm)	Three point bending strength (MPa)	Fracture toughness (MPa·m ^{1/2})	Rolling fatigue life (cycle)	
	Si ₃ N ₄	Electro- conductivity rendering agent		Rare earth element oxide	Al ₂ O ₃	AlN	Other component											
		SiC	Other component															
Example	2	65	12	Mo ₂ C	12	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	9 × 10 ⁶	1020	6.5	> 1 × 10 ⁷
	3	59	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	4 × 10 ⁴	1040	6.3	> 1 × 10 ⁷
	4	58	28	Mo ₂ C	3	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	2 × 10 ⁵	1020	6.1	> 1 × 10 ⁷
	5	55	19	Mo ₂ C	15	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	1 × 10 ⁴	960	6.1	> 1 × 10 ⁷
	6	75	17	Mo ₂ C	4	Y ₂ O ₃	2	2	—	—	—	1850 × 4 × 0.9	1700 × 1 × 98	Up to 0.01	1 × 10 ⁷	950	6.2	> 1 × 10 ⁷
	7	63	16	Mo ₂ C	8	Y ₂ O ₃	10	2	1	—	—	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	1 × 10 ⁶	1000	6.5	> 1 × 10 ⁷
	8	62	16	Mo ₂ C	8	Y ₂ O ₃	4	5	4	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 30	Up to 0.01	9 × 10 ⁵	1050	6.4	> 1 × 10 ⁷
	9	64	16	Mo ₂ C	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1850 × 4 × 0.9	————	0.2	2 × 10 ⁵	980	6.6	> 1 × 10 ⁷
	10	63	20	Mo ₂ C	3	Y ₂ O ₃	4	3	2	TiO ₂	5	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	3 × 10 ⁶	1040	6.1	> 1 × 10 ⁷
	11	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	ZrO ₂	2	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	5 × 10 ⁴	1070	6.4	> 1 × 10 ⁷
Comparative example	12	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	HfO ₂	2	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	4 × 10 ⁴	1080	6.4	> 1 × 10 ⁷
	13	64	16	MoSi ₂	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	9 × 10 ⁴	1080	6.6	> 1 × 10 ⁷
	14	64	16	WC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	5 × 10 ⁵	1050	6.4	> 1 × 10 ⁷
	15	64	16	TaC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	3 × 10 ⁵	1100	6.6	> 1 × 10 ⁷
	16	64	16	NbC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	9 × 10 ⁴	1120	6.7	> 1 × 10 ⁷
	17	61	16	Mo ₂ C	10	Er ₂ O ₃	7	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	1 × 10 ⁵	1100	6.7	> 1 × 10 ⁷
	18	63	16	Mo ₂ C	10	CeO ₂	5	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	1 × 10 ⁵	1010	6.6	> 1 × 10 ⁷
	19	63	16	Mo ₂ C	10	Nd ₂ O ₃	5	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	2 × 10 ⁵	1080	6.5	> 1 × 10 ⁷
	20	61	16	Mo ₂ C	10	Dy ₂ O ₃	7	3	2	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 30	Up to 0.01	1 × 10 ⁵	1100	6.6	> 1 × 10 ⁷
	4	71	10	Mo ₂ C	8	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	1 × 10 ⁶	1100	6.8	> 1 × 10 ⁷
Comparative example	5	53	30	Mo ₂ C	6	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	1 × 10 ⁴	920	5.8	8 × 10 ⁶
	6	70	17	Mo ₂ C	2	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	2 × 10 ⁸	1070	6.7	> 1 × 10 ⁷
	7	53	19	Mo ₂ C	17	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	0.05	8 × 10 ³	890	5.9	8 × 10 ⁶
	8	66	16	Mo ₂ C	10	Y ₂ O ₃	1	3	3	TiO ₂	1	1850 × 4 × 0.9	1700 × 1 × 98	0.1	4 × 10 ⁵	870	5.7	7 × 10 ⁶
	9	55	16	Mo ₂ C	10	Y ₂ O ₃	12	3	3	TiO ₂	1	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	2 × 10 ⁵	900	5.9	8 × 10 ⁶
	10	61	20	Mo ₂ C	3	Y ₂ O ₃	4	3	2	TiO ₂	7	1800 × 4 × 0.7	1700 × 1 × 98	Up to 0.01	2 × 10 ⁶	890	6.0	9 × 10 ⁶



Table 4

Sample	Material composition (mass %)							Sintering condition temperature x time x pressure (°C) x (hr) x (MPa)	HIP condition temperature x time x pressure (°C) x (hr) x (MPa)	Crushing strength (MPa)	Rolling fatigue life (hr)	Defects & static electricity				
	Si ₃ N ₄	Electro- conductivity rendering agent		Rare earth element oxide	Al ₂ O ₃	AlN	Other component									
		SiC	Other component													
Example	2B	65	12	Mo ₂ C	12	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	240	> 400	No defect
	3B	59	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	250	> 400	No defect
	4B	58	28	Mo ₂ C	3	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	230	> 400	No defect
	5B	55	19	Mo ₂ C	15	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	260	> 400	No defect
	6B	75	17	Mo ₂ C	4	Y ₂ O ₃	2	2	—	—	—	1850 x 4 x 0.9	1700 x 1 x 98	210	> 400	No defect
	7B	63	16	Mo ₂ C	8	Y ₂ O ₃	10	2	1	—	—	1800 x 4 x 0.7	1700 x 1 x 98	220	> 400	No defect
	8B	62	16	Mo ₂ C	8	Y ₂ O ₃	4	5	4	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	255	> 400	No defect
	9B	64	16	Mo ₂ C	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1850 x 4 x 0.9	—	230	> 400	No defect
	10B	63	20	Mo ₂ C	3	Y ₂ O ₃	4	3	2	TiO ₂	5	1800 x 4 x 0.7	1700 x 1 x 98	240	> 400	No defect
	11B	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	ZrO ₂	2	1800 x 4 x 0.7	1700 x 1 x 98	250	> 400	No defect
	12B	58	20	Mo ₂ C	10	Y ₂ O ₃	4	3	3	HfO ₂	2	1800 x 4 x 0.7	1700 x 1 x 98	255	> 400	No defect
	13B	64	16	MoSi ₂	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	250	> 400	No defect
	14B	64	16	WC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	240	> 400	No defect
	15B	64	16	TaC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	250	> 400	No defect
	16B	64	16	NbC	10	Y ₂ O ₃	4	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	270	> 400	No defect
	17B	61	16	Mo ₂ C	10	Er ₂ O ₃	7	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	280	> 400	No defect
	18B	63	16	Mo ₂ C	10	CeO ₂	5	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	230	> 400	No defect
	19B	63	16	Mo ₂ C	10	Nd ₂ O ₃	5	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	240	> 400	No defect
	20B	61	16	Mo ₂ C	10	Dy ₂ O ₃	7	3	2	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 30	250	> 400	No defect
	Comparative example	4B	71	10	Mo ₂ C	8	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	250	> 400
5B		53	30	Mo ₂ C	6	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	190	355	No defect
6B		70	17	Mo ₂ C	2	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	230	> 400	Defects
7B		53	19	Mo ₂ C	17	Y ₂ O ₃	4	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	185	330	No defect
8B		66	16	Mo ₂ C	10	Y ₂ O ₃	1	3	3	TiO ₂	1	1850 x 4 x 0.9	1700 x 1 x 98	180	345	No defect
9B		55	16	Mo ₂ C	10	Y ₂ O ₃	12	3	3	TiO ₂	1	1800 x 4 x 0.7	1700 x 1 x 98	200	360	No defect
10B		61	20	Mo ₂ C	3	Y ₂ O ₃	4	3	2	TiO ₂	7	1800 x 4 x 0.7	1700 x 1 x 98	190	370	No defect